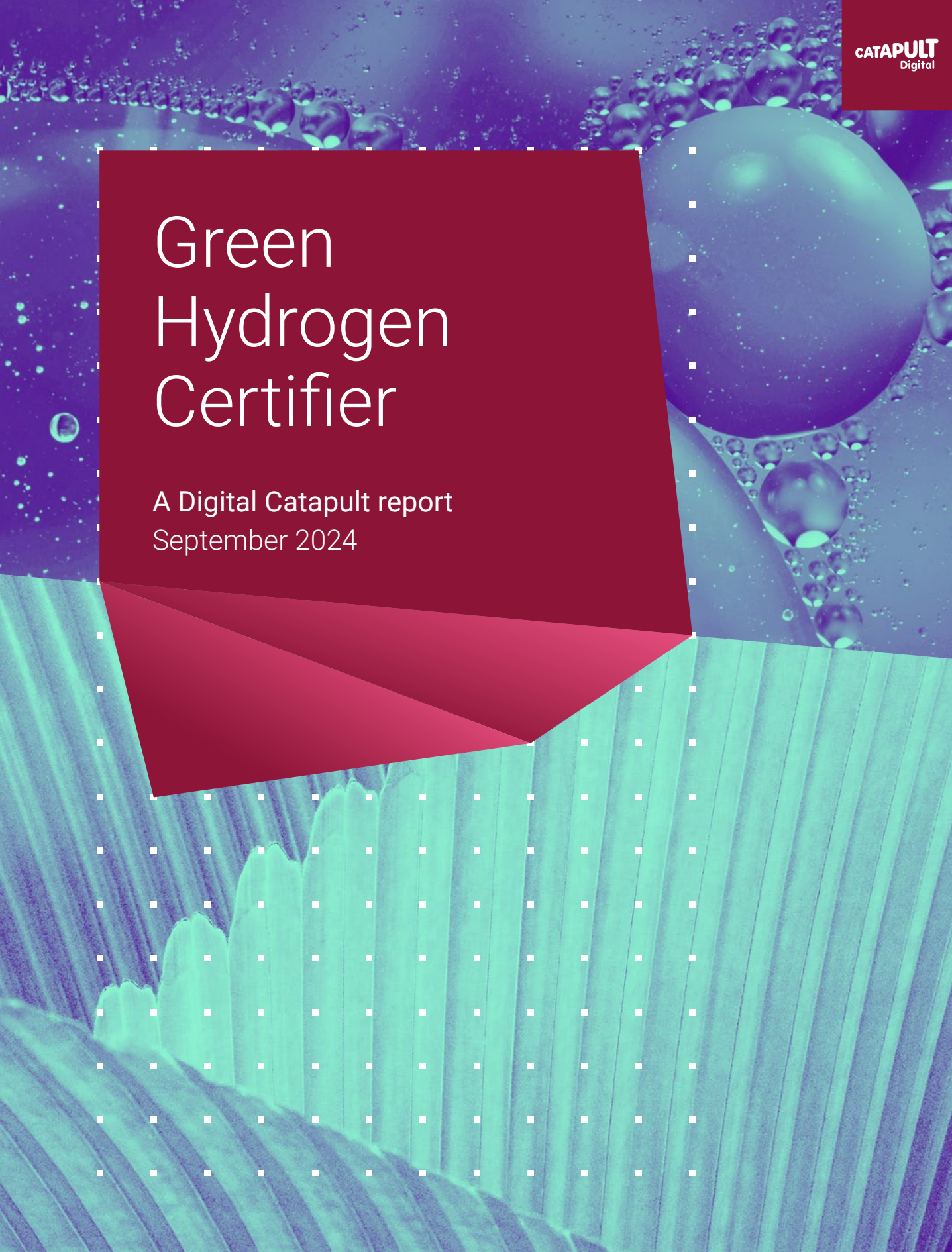

Green Hydrogen Certifier

A Digital Catapult report

September 2024

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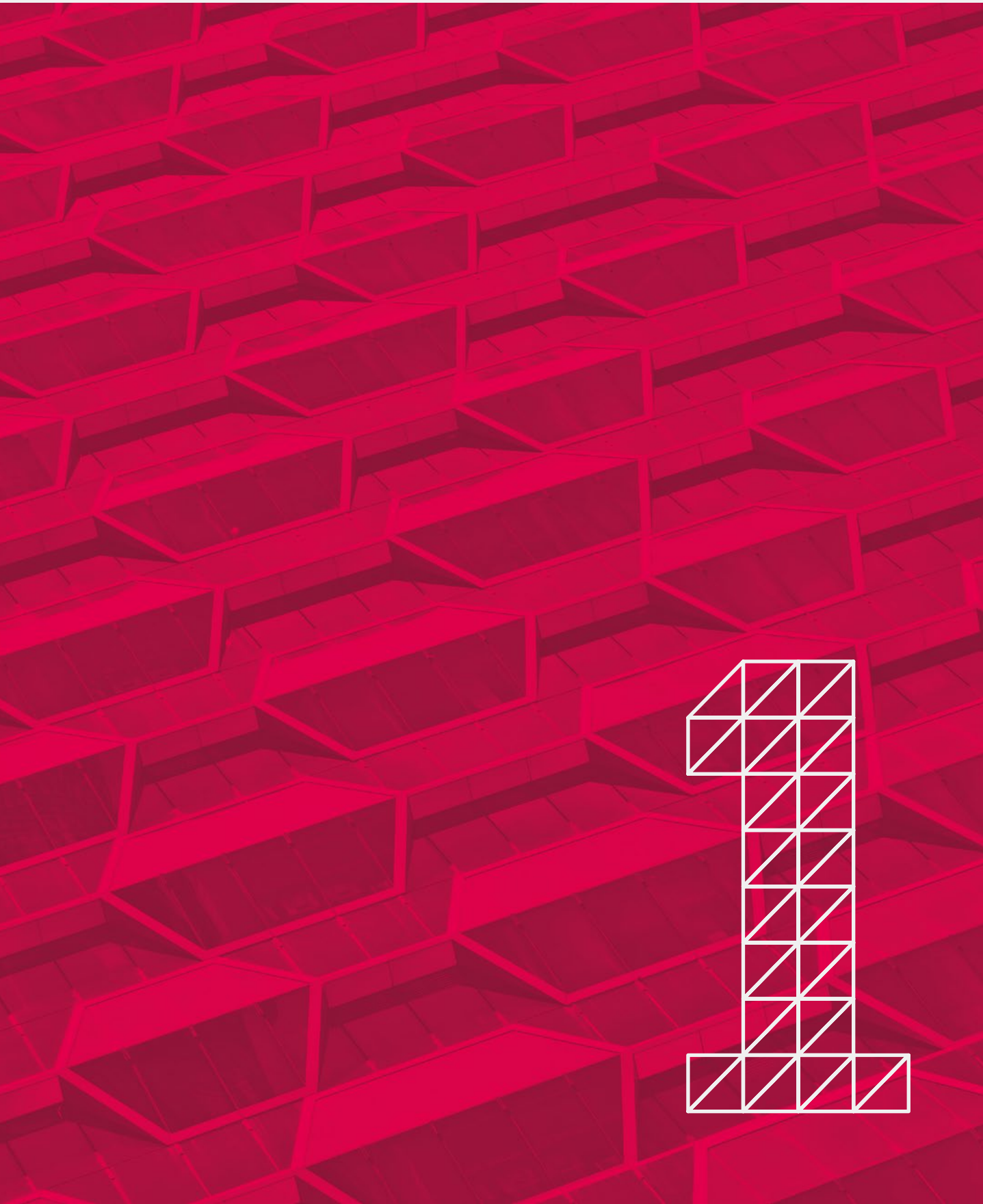


Executive Summary

The global hydrogen economy to reach $8tn annually by 2050, driven by the critical role hydrogen will play in delivering a net zero future.

Low Carbon Hydrogen, or Green Hydrogen, is derived through the electrolysis of water, powered by renewable energy, making it the most environmentally friendly form the fuel, especially when compared to blue or grey hydrogen, that are produced through steam reformation of methane (CH4).

The ability to verify and trace green hydrogen across a supply chain is incredibly important. Verifying green hydrogen ensures its production is truly sustainable, meets environmental standards, reduces carbon footprint, builds trust in green energy markets, and promotes investment in clean technologies.

Digital Catapult has developed an end-to-end demonstration of a potential digital certification solution for hydrogen production in the UK.

This has been developed through a user-centric design process, drawing in insights from persona mapping of organisational behaviours to create a balanced solution.

The project adopted a distributed systems approach which:

- Reflects the real-world distributed multi-party nature of the hydrogen ecosystem
- Respects individual sovereignty over actions and data management
- Avoids data concentration into a central store, with a single point of failure
- Presents a highly redundant and available solution

By combining a distributed ledger, distributed file store, and decentralised identities, it was possible to create a cohesive demonstration of a working certification solution that functions without a central controller, yet still results in verifiable provenance of low carbon hydrogen.

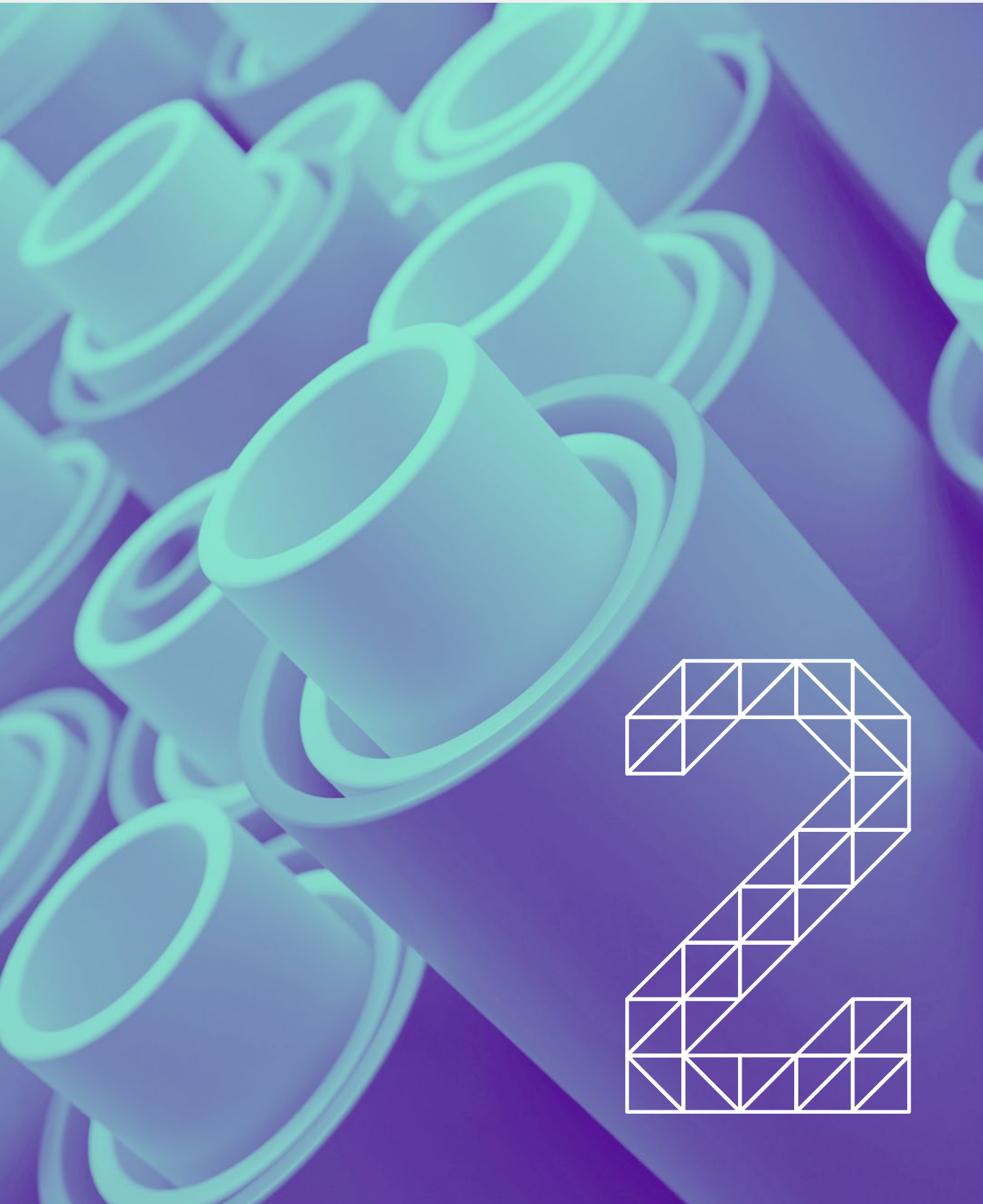
This sociotechnical approach to certification is an attractive solution to this difficult multi-party coordination challenge, underpinning a potentially valuable sector of the future UK economy.

A green hydrogen certifier in the UK would boost market confidence, attract investment, ensure regulatory compliance, support net-zero targets, foster innovation, create jobs, and establish the UK as a leader in sustainable hydrogen production and trade.

> We want the UK to become a key player in the international market for hydrogen and related goods and services, particularly with regard to exporting hydrogen to continental Europe where we see an increasing hydrogen demand.
>
> Government intends to launch a domestically focused certification scheme from 2025 [...] The government's aim is for the scheme to be available UK-wide and initially voluntary. It will demonstrate compliance with the Low Carbon Hydrogen Standard (LCHS) to show the emissions credentials from hydrogen production ("well-to-gate").
>
> The scheme will therefore be open to producers of hydrogen that can meet the LCHS, and their supply chains.

Key aspirations highlighted in the Government Response to the Low Hydrogen Certification Scheme consultation, published by the Department for Energy Security and Net Zero in October 2023.

These aspirations and intentions echo the sentiments of the companies engaged in Digital Catapult's discovery process.



System Design

We believe that a fair, effective, and efficient hydrogen certification system operating upon verifiable data will enable free market economics and support the UK hydrogen economy in the following ways:

- Instil confidence and trust in the emerging low carbon hydrogen economy
- Create opportunities for entrepreneurship and innovation
- Encourage novel entrants and safe operations at all production sites
- Encourage more sustainable behaviours
- Grow inward investment and UK export opportunities

Our demonstrator was therefore designed to encapsulate many of the desired features and behaviours of a workable national-scale hydrogen certification solution. These include:

- Enhancing trust through the verifiability of provenance of low CO_2e hydrogen back to low CO_2e energy sources
- Ensuring verifiably safe hydrogen production from certified producers and equipment
- Preventing bad or unauthorised actors from selling hydrogen in the UK market
- Enabling transparent certification visualisation and management

Distributed Systems Approach

What is a Distributed System?

Distributed Systems are collections of independent components (companies, computers, systems or services) who coordinate by passing messages directly between each other without a central controller.

Digital Catapult's ecosystem engagement and interview process, alongside the findings of the government's October 2023 report, confirmed that a Distributed Systems approach was most appropriate for developing a technological solution to the challenge of reliable and trustworthy low carbon hydrogen certification.

Adopting a Distributed Systems approach:

- Reflects the real-world distributed multi-party nature of the hydrogen ecosystem
- Respects individual sovereignty over actions and data management
- Avoids data concentration into a central store, with a single point of failure
- Presents a highly redundant and available solution

This approach combines agile principles of user engagement, consideration of behavioural incentives and disincentives, and finally making specific technological selections to deliver intended systematic outcomes by default.

We began the design phase by first considering the scope of the demonstrator.

Demonstrator Scope

This demonstration focusses on a generic, yet recognisable representation of low carbon (green) hydrogen in the UK.

Given the early nature of the entire sector in the UK, with only minimal connectivity and interactivity, Digital Catapult considered it appropriate to adopt a ‘greenfield’ approach when designing its hypothetical demonstrator. This meant that there was no consideration of the need to integrate with existing digital infrastructure or plant management software, for example.

We also discounted any need for marketplace activities, such as buying or selling certified hydrogen, or any payment handling to be demonstrated at this time. We instead reasoned that existing institutions and software solutions will perform these functions external to any certification solution. Perhaps at some point in the future, those systems would communicate with the certification system in order to obtain verifiable data on which to act. This could be facilitated in a number of ways.

Instead, a blank slate was used to allow free-form design of a ‘maximally optimal’ solution purely for hydrogen certification, based upon the best and most appropriate digital technologies currently available.

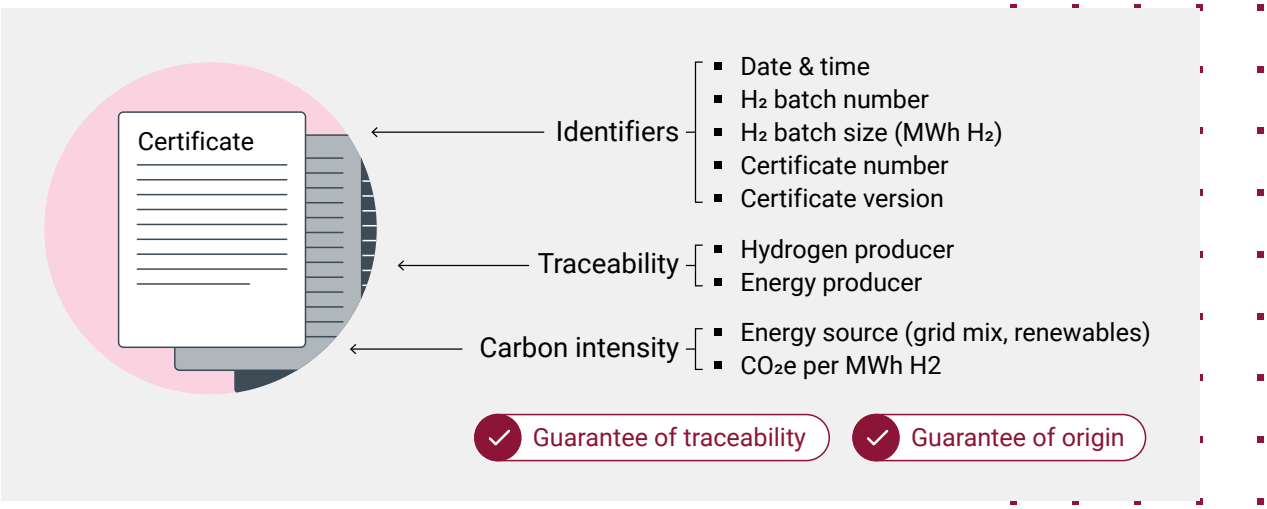
Certification Data

We opted to build our system so that it was capable of capturing only those mandatory data fields proposed as essential reporting requirements in line with the LCHS – the standard to be adopted by the UK government.

These include the:

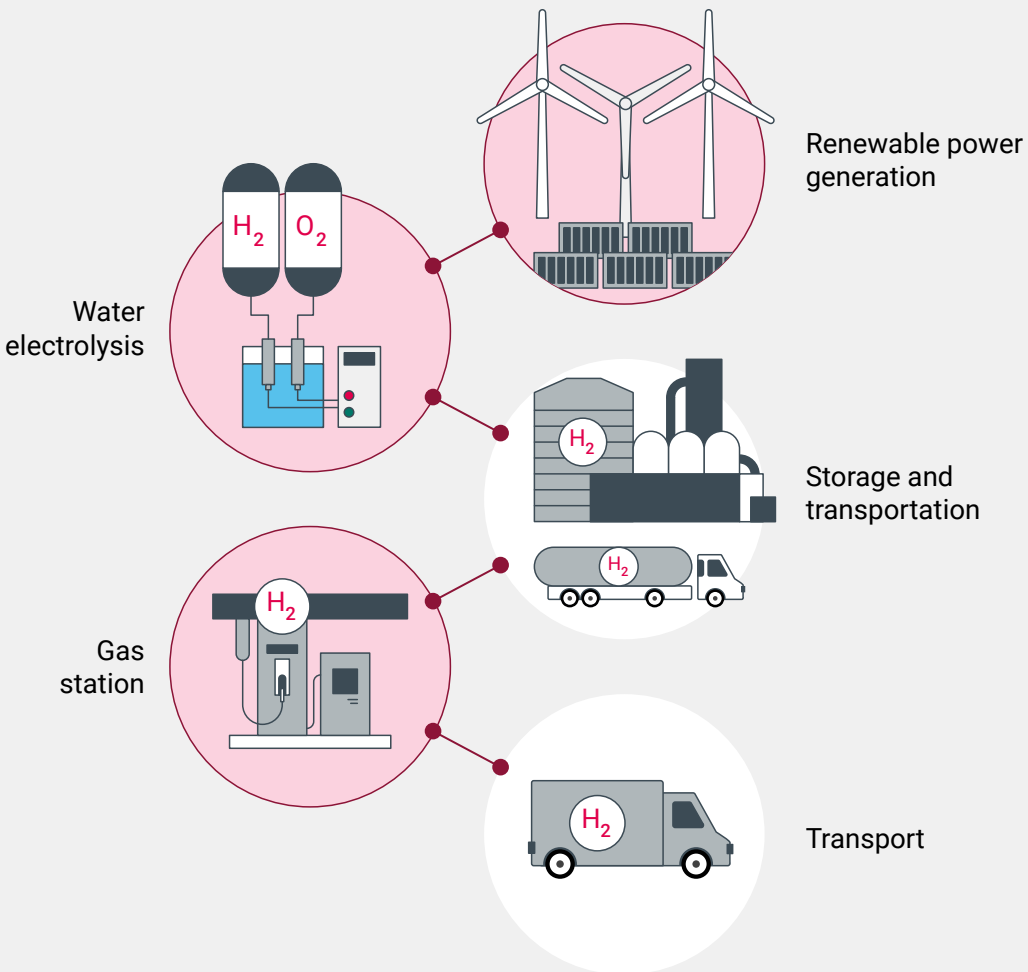
- Actual emissions associated with the production of hydrogen (the carbon embodiment of the batch of hydrogen)
- The method used to produce the hydrogen
- Other fields to enhance traceability (producer identity, timestamps)
- Energy embodied in a batch of hydrogen in units of Watt-hours (Wh)

The only mandatory field we are not capturing at this time is the confirmation of compliance with input and electricity sustainability criteria. Instead, we are opting to capture the provider of the energy used in the production of the certified batch, as this enables auditability of their sustainability credentials.



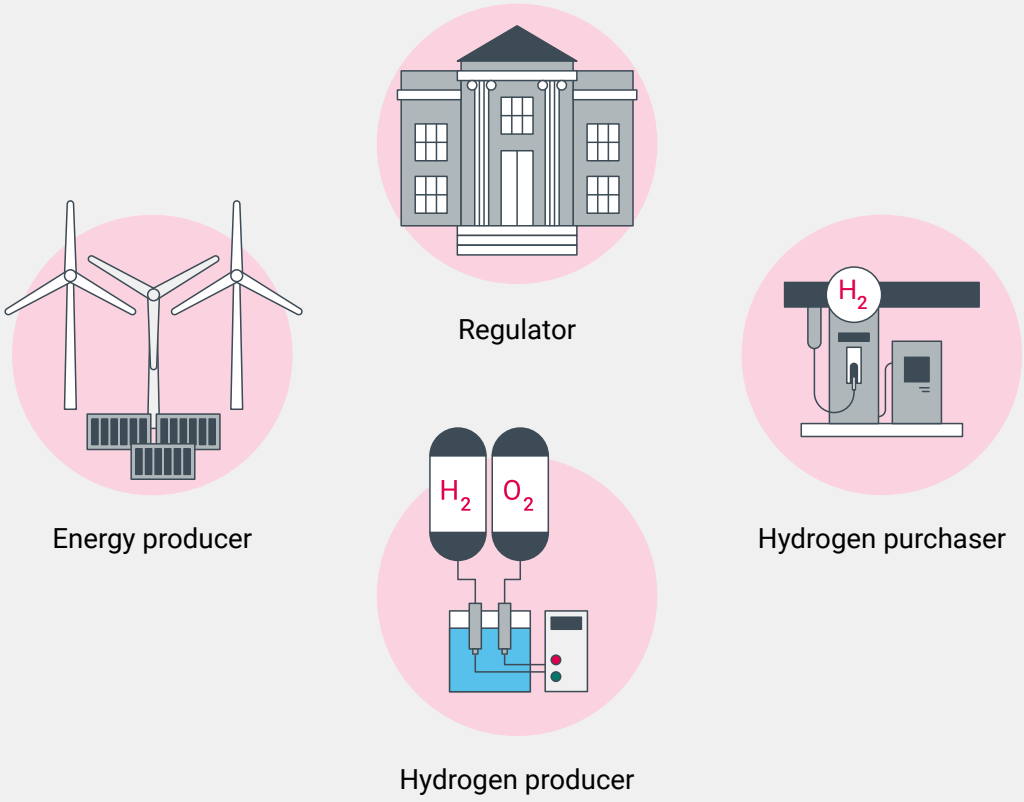
Developing Personas

While the future hydrogen supply chain will contain multiple diverse actors involved in a range of hydrogen production techniques, in addition to transportation, handling, storage, and usage, we elected to focus only on representing the production of electrolytic hydrogen from “well-to-gate”. This still represents more than half of the UK’s projected hydrogen production by 2030.



We also chose to only map out a simplistic 1:1 relationship between an energy supplier and hydrogen producer. This does mean that there was no representation of the complexity of contractual power purchase agreements (PPAs) between generators and consumers.

In addition to these two key roles, we introduced two additional personas, the regulator and a consumer, for a total of four generic identities to be modelled in the system:



Using personas allows us to model and explore the individual behaviours of each actor within the hydrogen ecosystem, and when interacting with any certification solution.

Real-World Considerations

While we discarded a number of complexities in order to deliver a basic functional representation of hydrogen certification in the UK, our design did however consider the real-world nature of organisations in the sector:

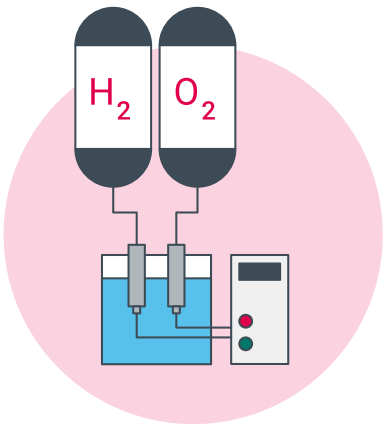
- Business relationships and ownership structures
- Data privacy concerns to ensure widespread adoption of the solution at scale
- Operational concerns that may prevent businesses from using the solution
- Adverse behaviours that must be avoided or overcome to assure end-user confidence in any hydrogen certified through the system

This also included the naturally distributed nature of hydrogen and energy production within the UK. Multiple geographically separated organisations with independent ownership structures are required to interact to not only generate electrolytic hydrogen, but also compress, convert, store, and deliver it to the end user.

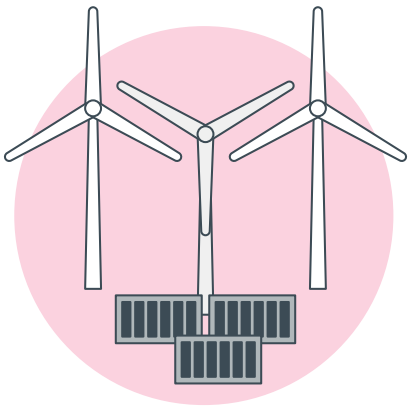
Behavioural Analysis

Combining the work above, we theorised the primary motivations for each of the non-consumer personas, and the range of potential adverse effects that these may have on the overall ecosystem if users were allowed to behave only in their own best interests by the certification system.

With an understanding of the motivations and potential adverse behaviours and impacts of each major persona, we were able to propose technological mitigations to many of these, in order to create a balanced system design.



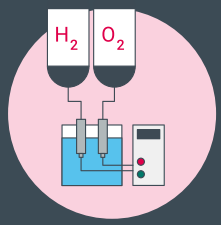
Hydrogen producer



Energy supplier

Regulator

Hydrogen Producer

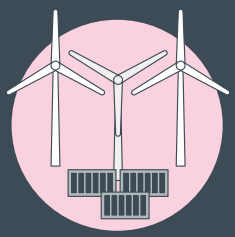


Primary Motivations:

- Maximise shareholder profits
- Comply with the letter of regulations to ensure the above

Personal benefit	Adverse behaviour	System impact	Mitigation
Sell 'green' hydrogen at a premium. Win customers interested in green hydrogen.	Under-report carbon embodiment in a unit of hydrogen.	Non-green hydrogen mixed in with green hydrogen. Lower confidence in system. Harm UK export.	Do not allow hydrogen produces to self-certify gCO_2e in units of hydrogen produced.
Sell 'green' hydrogen at a premium. Win customers interested in green hydrogen.	Under-report energy consumption per unit of hydrogen, time shifting claims of hydrogen production to least polluting periods.	Non-green hydrogen mixed in with green hydrogen. Lower confidence in system. Harm UK export.	Signed commitments to kWh consumed. Independently operated smart meter system.
Appear to be better, 'greener' producer.	Hide any polluting/high eCO2 hydrogen units.	Lower confidence in UK hydrogen production. Harm UK export.	Do not allow hydrogen produces to self-certify gCO_2ein units of hydrogen produced. Uncertified hydrogen cannot be sold.
Claim sales on same 'green' unit of hydrogen multiple times	Double sell any hydrogen unit produced.	Lower confidence in system. Misallocation of funds.	Distributed ledger ensures singular transfer of possession.

Energy Supplier



Primary Motivations:

- Maximise shareholder profits
- Comply with the letter of regulations to ensure the above

Personal benefit	Adverse behaviour	System impact	Mitigation
Sell green energy at a premium. Win customers interested in green energy.	Misinform consumers and/or regulator about energy mix and emissions.	No pressure on electricity producers to generate / transition to green energy.	Send hydrogen producer signed commitments to gCO_2e/kWh
Sell green energy at a premium. Win customers interested in green energy.	Use renewable certification scheme with the lowest overheads / compliance burden.	No pressure on electricity producers to generate / transition to green energy.	System does not use existing GO or RIGO certification schemes, instead relies on raw data from energy producers.
Favour one downstream purchaser over another for financial gain.	Collude to report lower gCO_2e in certain hydrogen certificates.	Non-green hydrogen mixed in with green hydrogen. Lower confidence in system. Harm UK export opportunities.	Signed commitments to gCO_2e/kWh conversions, enabling automated spot checks by regulators

Regulator

Primary Motivations:

- Ensure functioning of UK hydrogen ecosystem
- Maximise cost effectiveness of oversight

Personal benefit	Adverse behaviour	System impact	Mitigation
Relaxed oversight to reduce costs.	Inadequate adjudication and intervention. UK ecosystem will appear to producing green hydrogen.	Lower confidence in UK hydrogen production. Production remains polluting. Harm UK export opportunities.	Automate as many regulatory actions as possible. Regulatory actions and enforcements are carried out publicly.
Selectively enforce rules only on most obvious challenges or those with the lowest costs to prosecute.	Inconsistent adjudication that prefers certain actors over others. Power to shape market to maximise desired outcomes.	Fewer market entrants, tendency towards monopolisation. Green hydrogen production not optimised through free market competition.	Automate as many regulatory actions as possible. Regulatory actions and enforcements are carried out publicly.

Regulator can automatically spot-check most claims made by both energy producers and hydrogen producers in this system.

Balanced System Design

We translated our behavioural analysis into an optimal user flow for generating a hydrogen certificate, demonstrating the actions of the Hydrogen Producer, Energy Supplier, and the role of a distributed ledger within the system. This includes important guard-rails to ensure equitable outcomes for all stakeholders.

The first critical design element of our solution is that the Hydrogen Producer should not be permitted to record both the hydrogen produced and the carbon embodiment data in the final certificate. To do so would enable the Hydrogen Producer to misrepresent their carbon intensity at will, and in a manner that could only be discovered with a full manual data audit.

Instead, we believe that there must be a balanced separation of roles and responsibilities within the system to avoid any opportunity for fraud. In our design, the Hydrogen Producer initiates a certificate and records the batch size, and the Energy Supplier adds the carbon intensity data.

We implemented cryptographically signed communication of specific production data (timings and energy consumption) between the Hydrogen Producer and the Energy Supplier in order for the Energy Supplier to calculate the relevant intensity data for the batch to be certified. This secure channel ensures the data is protected against intrusion and tampering.

Furthermore, by passing this cryptographically signed production data directly between the two parties, external to the ledger, others are prevented from calculating production efficiency from the data recorded on the ledger. This preserves the business-critical interests of the Hydrogen Producer.

In order to prevent dishonesty and also safeguard against non-repudiation, the Hydrogen Producer must provide a cryptographic commitment to the production data on the ledger, alongside the batch information. A cryptographic commitment cannot be reversed to extract the data that produced it, but always results in the same commitment if repeated with the same inputs.

Before calculating the carbon intensity for the energy usage period, the Energy Supplier first verifies that the data received directly from the Hydrogen Producer recreates the relevant on-ledger commitment. This check keeps the Hydrogen Producer honest. The commitment and production data are also fully auditable by the Regulator in an automatable fashion, without leaking any business-critical information.

With these checks and balances in place, the only way to record improper information regarding carbon embodiment within a certificate is for both of these parties to collude. The system design further enables the Regulator to automatically audit and compare carbon intensity data from the same Energy Supplier across multiple signed certificates, strongly disincentivising any such behaviour.

While collusion may be possible on a smaller scale, in a full-scale production system with multiple relationships between actors (especially when considering the nature of power purchasing agreements), the chances of collusion would be statistically minimal and detectable.

Finally, we believe that the ecosystem as a whole benefits from Regulatory transparency and auditability. For this reason, the system will not allow the Regulator to cancel or revoke a certificate without first documenting their reasoning, and indelibly linking this to the certificate in question on the ledger. The documentation can then be audited as desired.

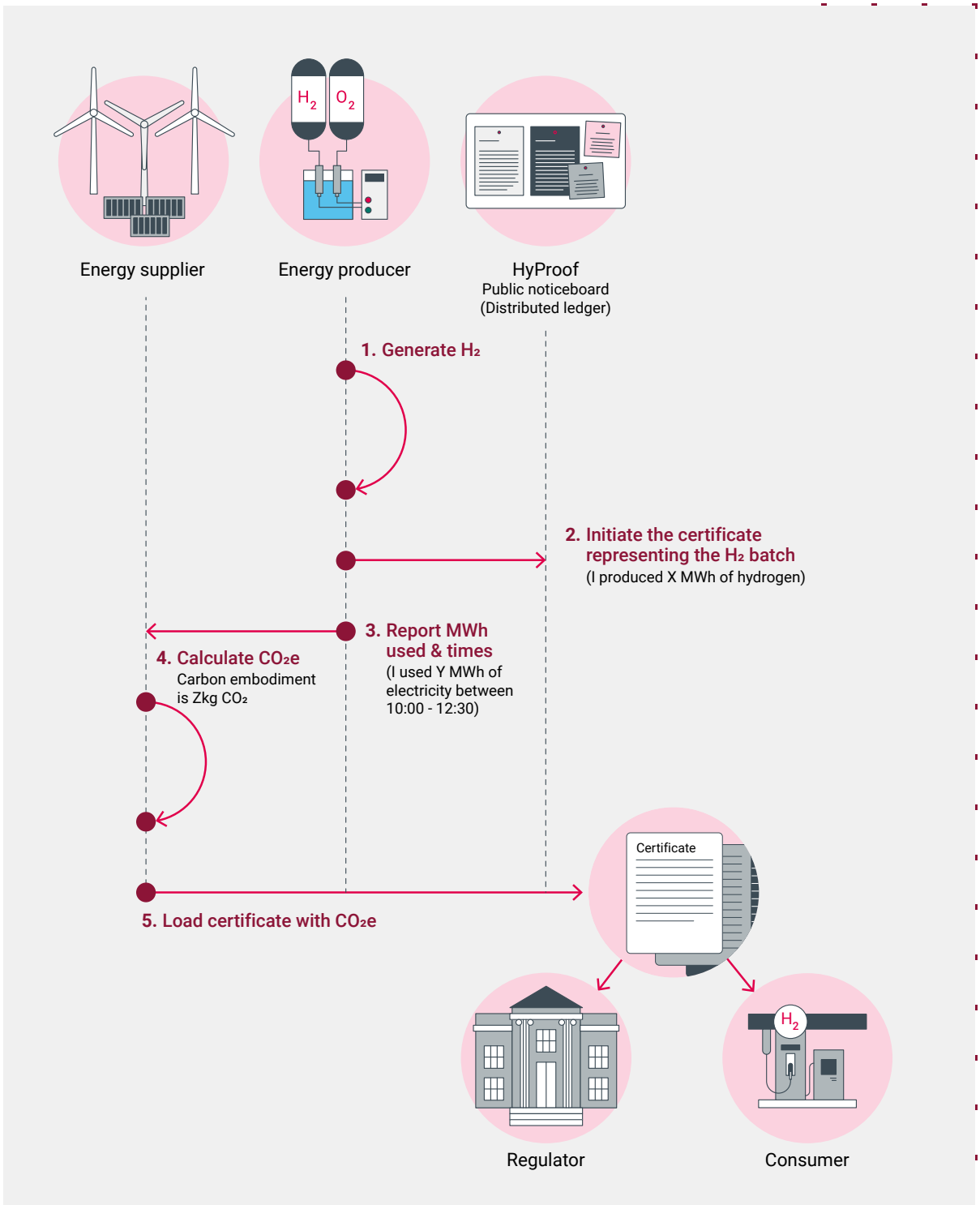
Final Workflow

The diagram on the next page illustrates the workflow described in the previous section with the following steps:

1. **The Hydrogen Producer first generates a batch of hydrogen to be certified**
2. **The Hydrogen Producer initialises the certificate on the ledger**
3. **The Hydrogen Producer transmits production data to the Energy Supplier**
4. **The Energy Supplier translates this production data into total embodied carbon**
5. **The Energy Supplier finalises the certificate with the embodied carbon data**

The revocation of a certificate by the Regulator happens outside this normal workflow.

Final Workflow Diagram



Implementation

Following the stages of background research, industry (user) engagement, persona development and system balancing, we proceeded to select technologies to implement the intended distributed multi-actor solution.

Technology Selection

The field of Distributed Systems contains a range of technologies for achieving coordination and interconnectivity between independent stakeholders through message passing, often in the face of unpredictable or adversarial conditions.

Our demonstrator combined distributed ledger technology (DLT), a distributed file store, and decentralised identifiers (DIDs) for inter-agent communication to present a fully distributed solution for verifiable low carbon hydrogen certification.

The specific implementations selected are all open source, well-supported, under active development, and with existing real-world deployments and suitable software licensing terms. These are described on the following pages.

Distributed Ledger Technology (DLT)

With our solution, we believe that the non-repudiable and indelible time ordering of data records to enable the verifiability of claims is essential for building trust between multiple independent parties without reliance on a central authoritative data controller.

We elected to use Substrate from Parity Technologies to deliver this functionality. Substrate is a framework and toolkit for building customised distributed ledgers, rather than a pre-packaged ledger solution.

Our ledger, named Sequence, has the following features:

- Byzantine Fault Tolerant consensus with deterministic finality
- Programmable runtime logic via a custom Domain Specific Language (DSL)
- Hot swappable runtime logic to enable seamless updates/upgrades in a live deployment

The second of these, our DSL, is what we believe provides the most unique value. Unlike many other programmable ledgers, by constraining the system to only enable specific state transitions we were able to overcome the halting problem without economic disincentives. In lay terms, this means that we do not need to worry about future developers accidentally implementing logic bombs that would crash the system or require the use of cryptocurrency.

Distributed File Store (IPFS)

The InterPlanetary File System (IPFS) was first launched in 2015 by Protocol Labs. It has grown to become the leading implementation of a public distributed file system for storing and exchanging non-stateful data objects.

Certain features of IPFS are very attractive for our demonstrator:

- Content-based addressing to guarantee the integrity of retrieved data
- Tuneable data sharding (fragmentation into linked blocks distributed across a network) and redundancy to provide high availability
- Open standard-driven implementations

Our demonstrator uses a private network implementation of go-IPFS (Kubo) in order to store and indelibly link documentation for certificate revocation to the relevant certificate when the Regulator undertakes this action.

Decentralised Identifiers (DIDs)

Decentralised IDentifiers (DIDs) are concerned with providing globally unique identifiers that belong to individuals or entities, rather than being centrally managed. The World Wide Web Consortium (W3C) approved the DID 1.0 specification as a recommendation in July 2022.

These technologies have seen growing uptake with live real-world implementations such as the:

- Government of British Columbia's usage for regulating organisational identity and credentialing
- US state of California's mDL (mobile driver's license)
- European Union's eIDAS identity solution
- Government of Bhutan's citizen identity solution

Our demonstrator uses DIDs to enable the regulator to manage (i) the onboarding and identification of verified parties into the system; and (ii) for relaying signed private communications linked to these verified identities between the Hydrogen Producer and the Energy Supplier regarding energy usage and production times.

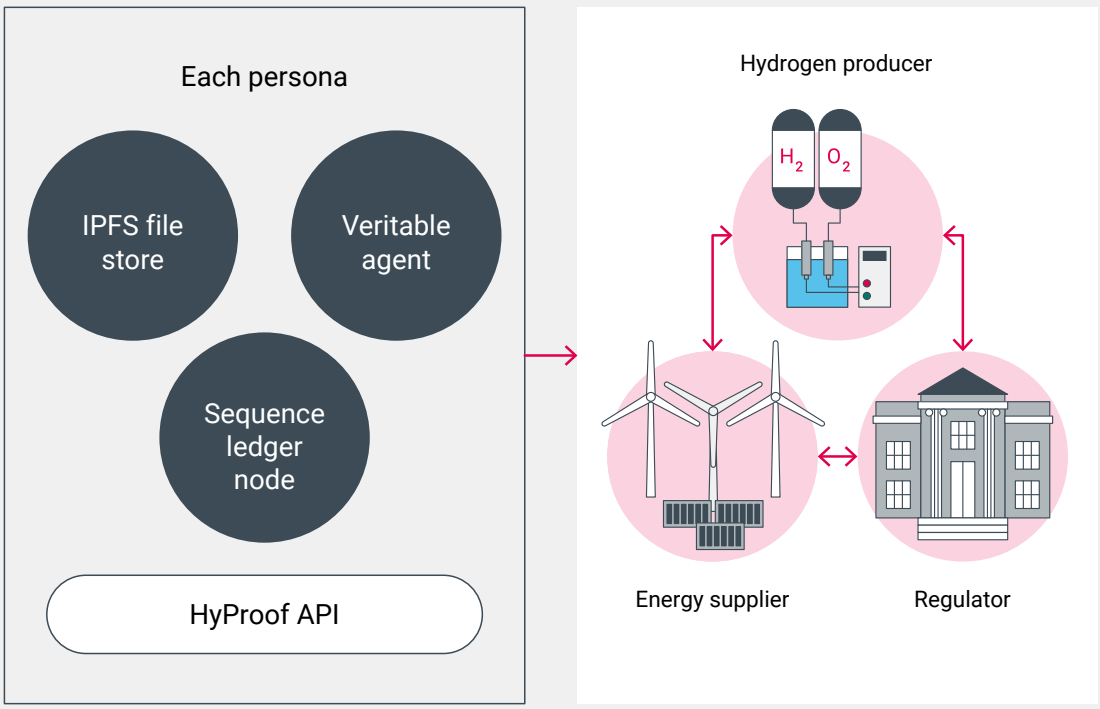
We chose to base our implementation, which we call Veritable, upon the Credo codebase from the OpenWallet Foundation.

System Architecture

Each persona within the demonstrator runs a combination of the services described above. These services communicate via an open, documented API.

The graphic user interface (the client) of the demonstrator is then able to access the information within each of these systems through the same API.

The software of the three major personas within the system communicate with each other to form a leaderless Distributed System as shown below:



Demonstrator Walk-Through

This section presents the final user interfaces developed for the demonstrator, showing the certification workflow for a batch of low carbon hydrogen.

We have purposely abstracted away any presentation of the underlying technological complexities regarding distributed ledgers, cryptographic commitments to data, or DID-based signed communications. We believe that this is a design principle that brings the field of Distributed Systems closer to real-world end users.

Instructions for running the demonstration on a local machine can be found in the open source public repository. The demonstrator works in most web browsers but is best viewed in Chrome.

Demonstrator Landing Page

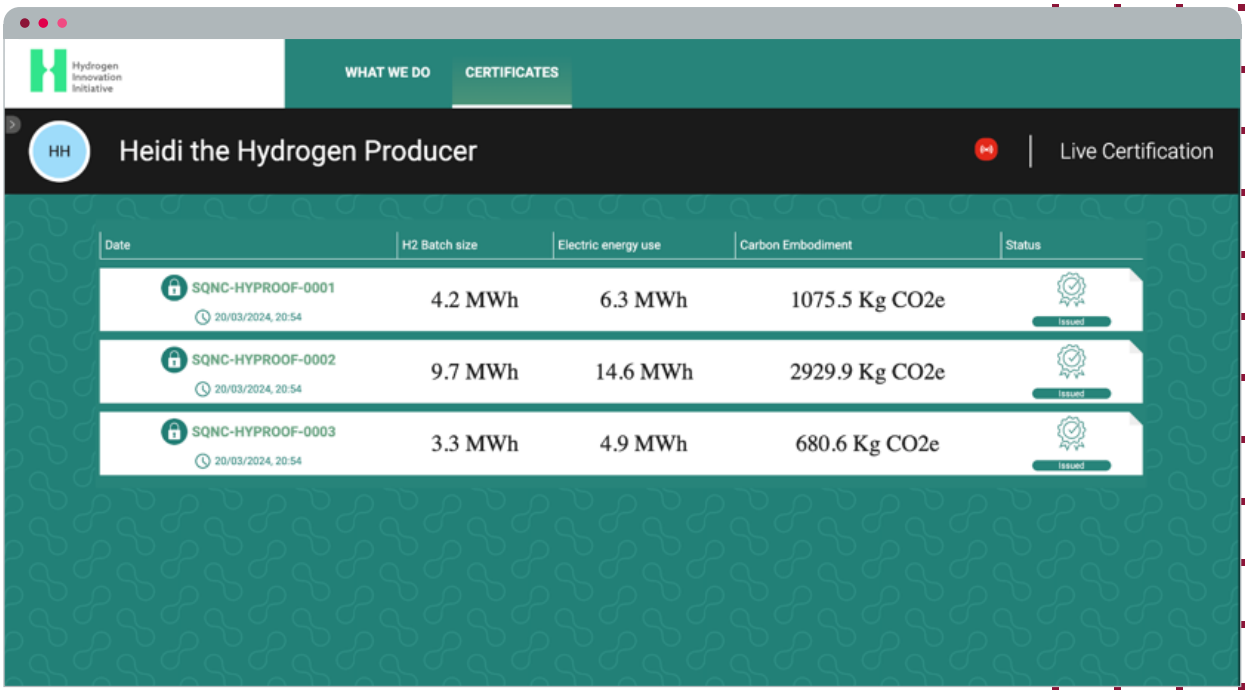


Image:
Demonstrator landing page

On first loading, the Demonstrator presents the user with a list of existing certificates for individual batches of hydrogen. Each one represents a different amount of hydrogen that has been certified, alongside the embodied CO2 for each batch, and other key details.

The demonstrator follows a happy path workflow along the following steps:

1. The Hydrogen Producer initialises a certificate
2. The Energy Supplier calculates the embodied CO2 (eCO2)
3. The Energy Supplier adds the eCO2 to the certificate
4. The system now issues the final certificate

One further workflow can be demonstrated for the Regulator:

- The Regulator reviews and revokes a certificate

The Hydrogen Producer Initialises a Certificate

The demonstration begins by first adopting the persona of the Hydrogen Producer who has generated a batch of hydrogen through electrolysis and is now seeking to have that batch certified.

In order to obtain a certificate for a new batch of hydrogen, the user clicks on the New Certificate button in the right hand panel. This will bring up an input page to record the start and end time of hydrogen production, the batch size to be certified, and the amount of electricity that was used to generate the hydrogen.

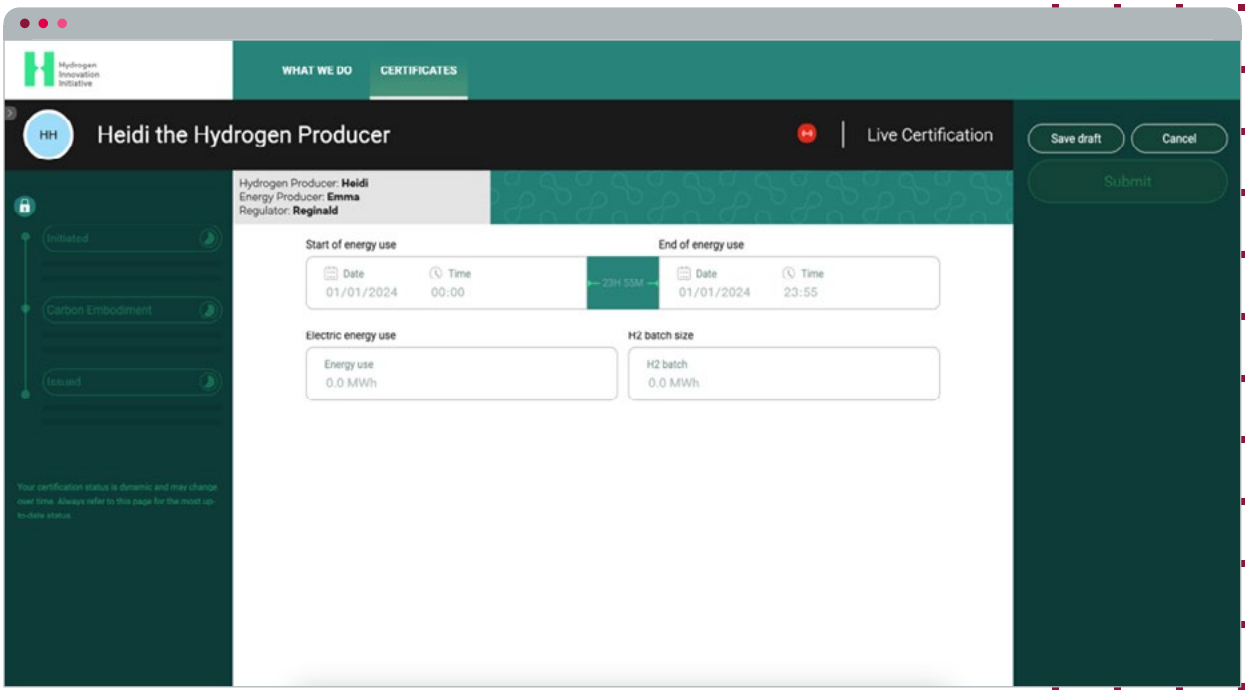


Image:
Hydrogen Producer data entry form

After entering all of the relevant information, the user clicks the ‘Submit’ button in the right hand panel. The system will now send this data to the shared ledger and display a small wait animation in the button.

The Hydrogen Producer also transmits a separate packet of data to the contracted Energy Supplier to allow them to complete the certification process. The panel on the left hand side of the screen will indicate when the certificate has been successfully Initiated on the ledger.

The Energy Supplier Completes the Certificate

The demonstration proceeds by changing persona using the arrow just below the Hydrogen Innovation Initiative logo in the top left hand side of the screen.

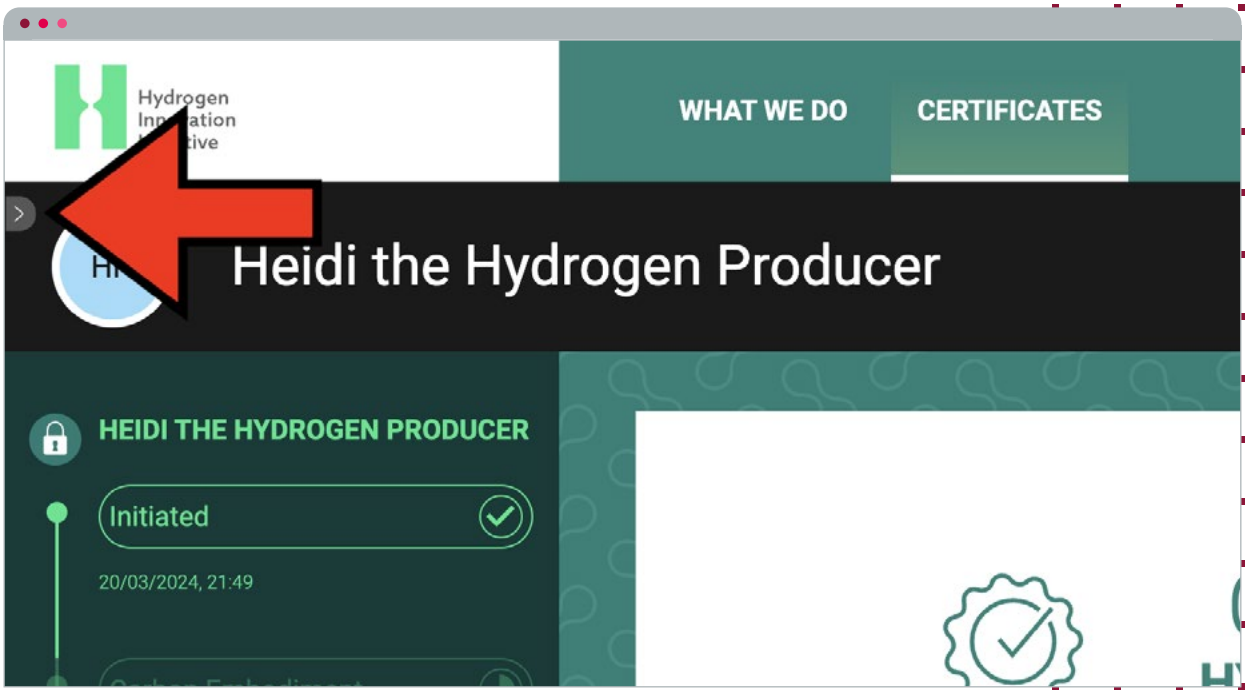


Image:
Location of the persona selector drawer

This opens a drawer showing the 4 personas available in the demonstrator. The user selects the Energy Supplier and the background turns green indicating a successful switch. The drawer can be closed by clicking the arrow again.

The Energy Supplier's work is automatically carried out by the system itself.

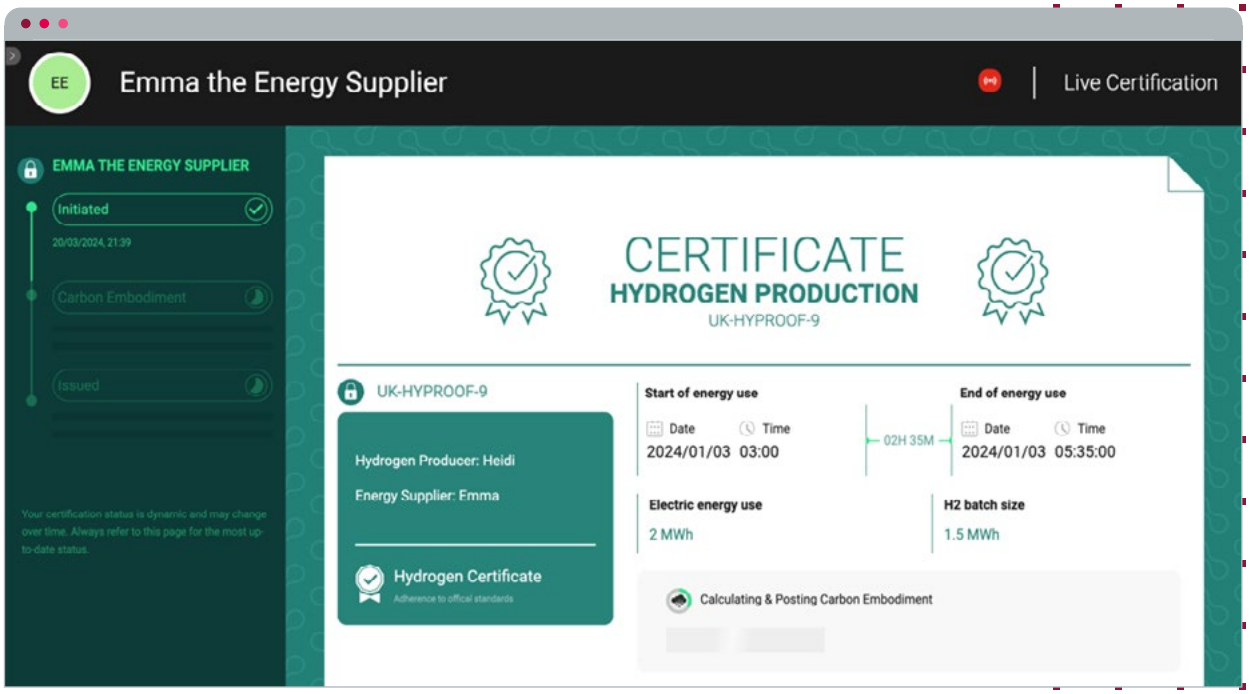


Image:
Location of the persona selector drawer

The following steps take place in the background:

1. **The Energy Supplier previously received a data packet from the Hydrogen Producer containing:**
   a. A cryptographic commitment to the content of this data
   b. The start time and end time of hydrogen production
   c. The total kWh of electricity used

2. **The Energy Supplier first checks if this additional private data aligns with what has been publicly recorded by the Hydrogen Producer on the ledger using the cryptographic commitment. This keeps the Hydrogen Producer honest**

3. **The Energy Supplier then calculates the embodied CO2 for the Hydrogen Producer's batch from:**
   a. The time window sent by the Hydrogen Producer
   b. The total kWh used by the Hydrogen Producer
   c. The Energy Supplier's knowledge of her carbon intensity over that period

4. **The Energy Supplier submits this embodied CO2 value to the ledger to be added to the certificate that the Hydrogen Producer previously initiated**

5. **The system updates the certificate into a final Issued state**

Viewing the Final Certificate

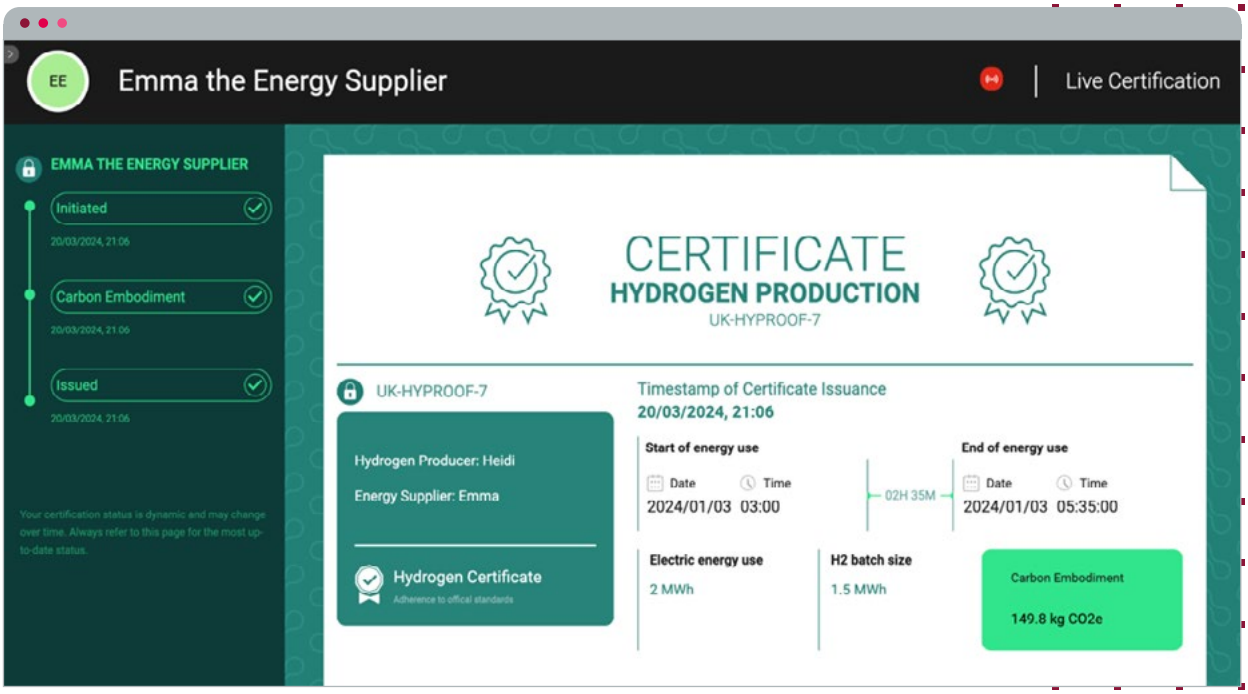


Image:
Final hydrogen certificate

Taking a look at the final certificate, it is clear to see it contains the following valuable information:

- Date and time of certification
- Guarantees of origin (the hydrogen producer and energy supplier)
- Batch size
- Total embodied CO2

The system also protects against certain personas obtaining information that they should not be allowed to see.

This can be demonstrated by keeping the current certificate on the screen and switching between personas using the left hand drawer.

Both the Hydrogen Producer and Energy Supplier see a certificate that has been generated from their local databases using a combination of entered or calculated data, and the information recorded on the ledger itself. As a result, both of these personas can see all of the data associated with a batch of hydrogen they collaboratively certified.

The Regulator and the Customer do not have access to the private data that the Hydrogen Producer shared with the Energy Supplier, so they do not have access to:

- The Hydrogen Producer's time window of production
- The total kWh used by the Hydrogen Producer
- The Energy Supplier's knowledge of her carbon intensity over that period

This means that these two personas only see the total batch size and the total carbon embodiment of that batch.

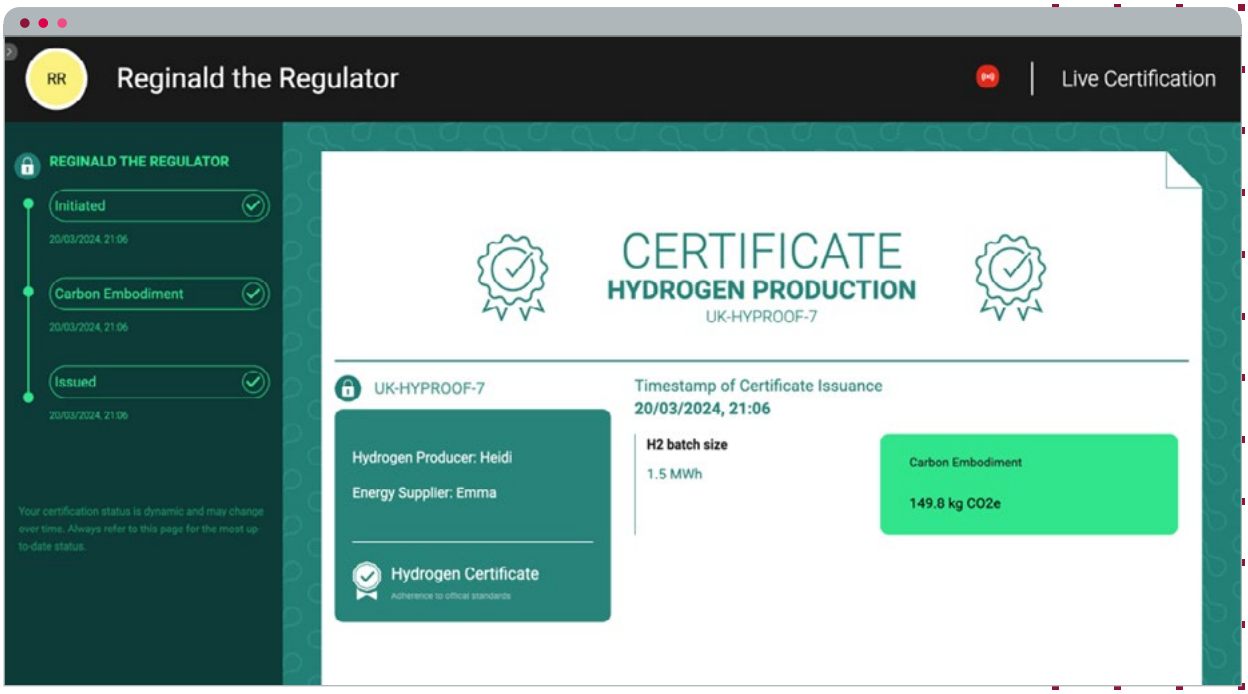


Image:
Final hydrogen certificate

If the Regulator wanted to obtain additional information for audit purposes, they could request this directly from the Hydrogen Producer or the Energy Supplier. The truth of this data could then be confirmed against the cryptographic data within the ledger, or against that transmitted between these two in order to generate the certificate.

In this way the Hydrogen Producer and the Energy Supplier keep each other honest, and the Regulator keeps them both honest.

Revoking a Certificate

One final action that is possible within the system is the ability for the Regulator to revoke a certificate.

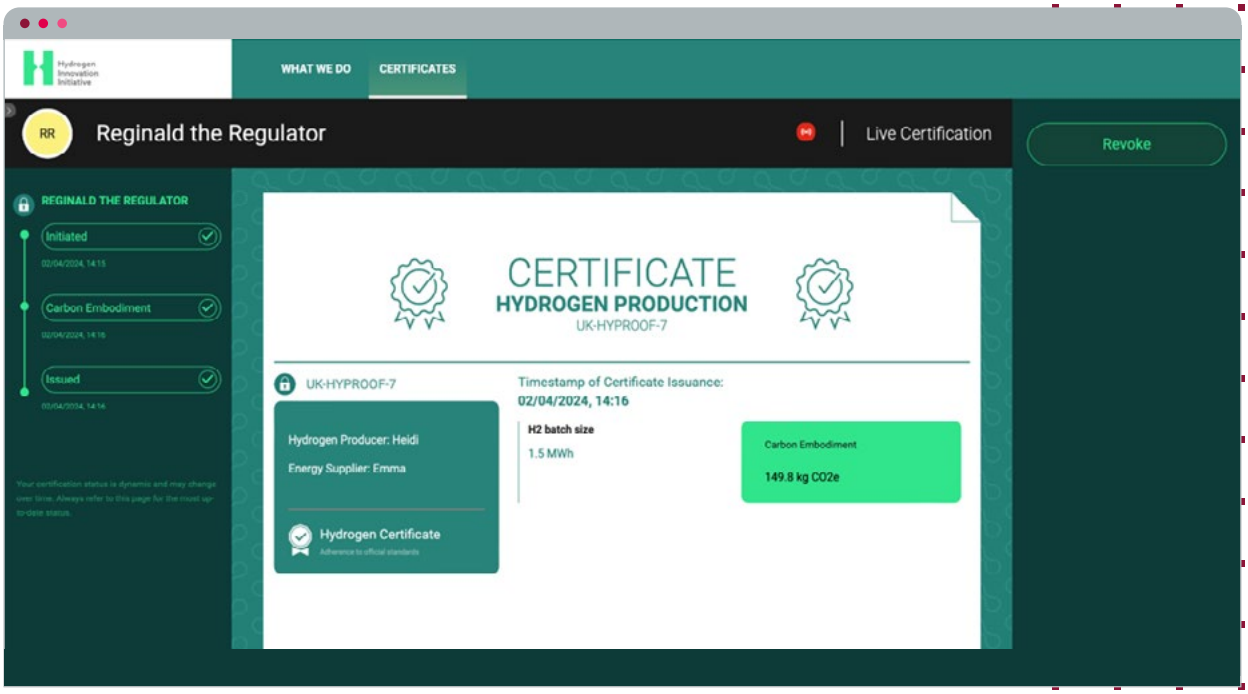


Image:
The Regulator's view of the certificate with the option to Revoke

However, in order to keep the Regulator themselves honest and auditable, the reasons for revocation must be recorded in an indelible, high integrity manner, and made available to others.

To demonstrate this functionality, the user now switches to the persona of the Regulator in the left hand drawer.

The Regulator has identified a problem with this latest hydrogen certificate. The user clicks on the Revoke button on the right hand side. This will pop up a form that asks for the reasons for revocation. This design prevents revocation without a reason first being given and linked to the certificate that is being revoked.

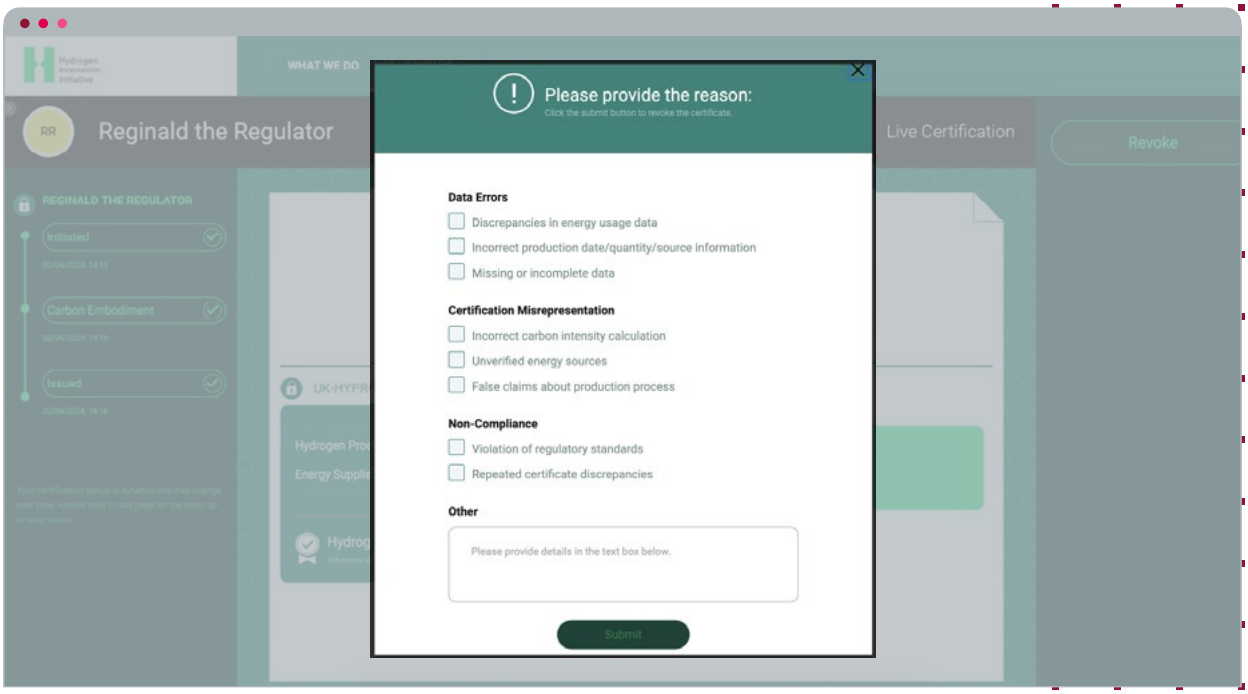


Image:
Revocation form

The user submits the completed form, and this is loaded into the system and attached to the relevant certificate. After a few seconds of processing, the certificate is now Revoked. This is instantly visible to all personas. All of the personas except for the Consumer have access to the reasons for revocation.

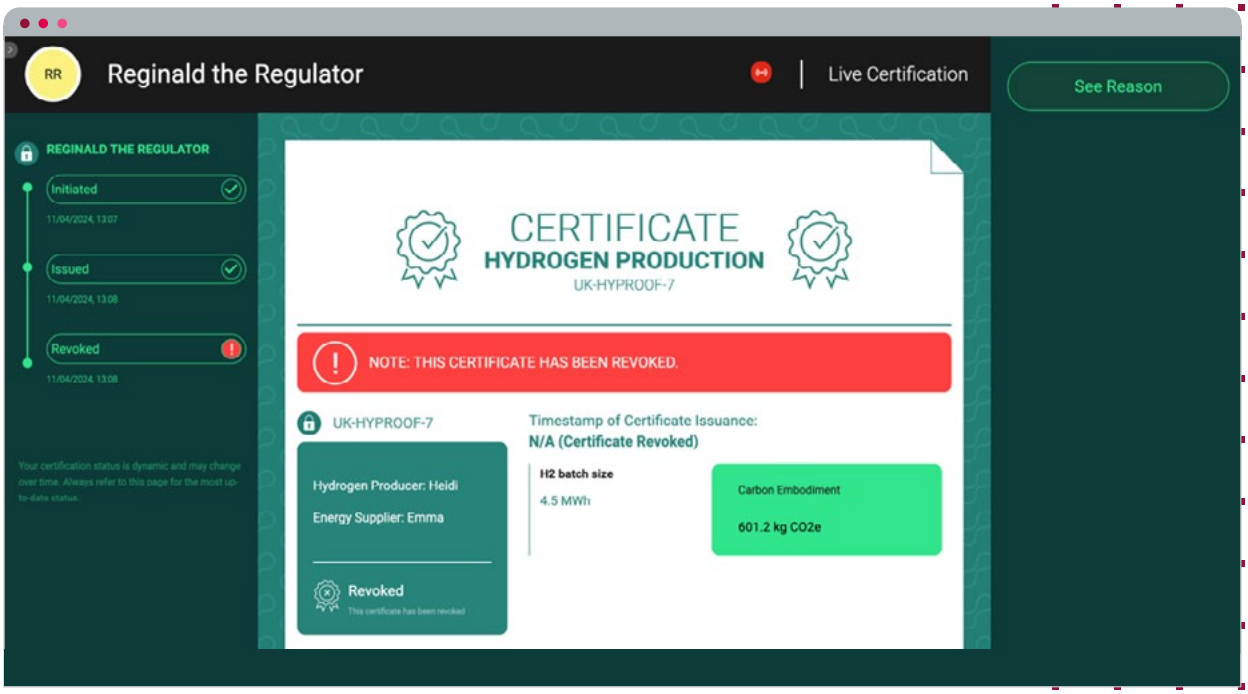
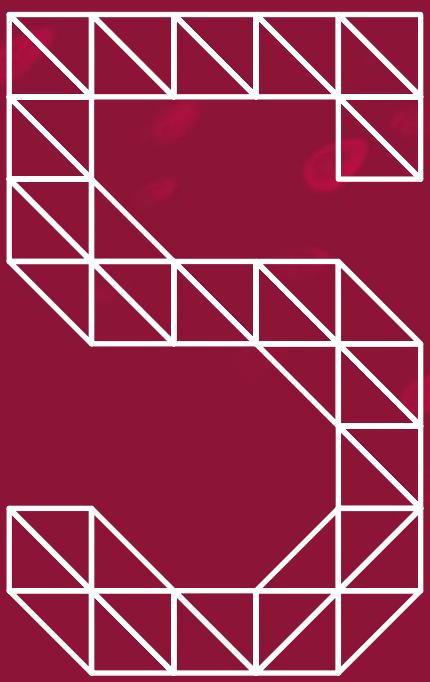


Image:
A revoked certificate, with a button to display the explanation for revocation



Conclusions & Considerations

Within the HII consortium, Digital Catapult successfully delivered a working demonstration of a verifiable hydrogen certification solution based upon a Distributed Systems approach.

Digital Catapult's Green Hydrogen Certifier demonstrated a number of principles:

- It is possible to engineer a balanced solution that considers the individual motivations and disincentives for stakeholders within the system
- A functional certification infrastructure can be deployed without a central data manager or controller
- Distributed Systems technologies including ledgers, file stores, and identifiers are sufficiently mature for use in model systems

Digital Catapult believes that the Green Hydrogen Certifier has the potential to make a positive impact on the UK's hydrogen ecosystem in many ways, not least of which is highlighting the potential of advanced digital technologies to address difficult challenges in new and useful ways.

We invite follow-up comments and discussions from two major groups of stakeholders:

Direct participants: any entity that is involved in the production or distribution of green hydrogen and sees themselves represented in one of the personas chosen for the demonstrator:

- Hydrogen Producer
- Energy Supplier
- Regulator
- Consumer

Observers and supporters: other parties who are keen on observing, learning, and commenting on the demonstrator at various levels - the concept, the implementation, and the impact it could have in the real world if taken to scale.

We also include in this second group those organisations outside the hydrogen sector who may be facing similar multi-party challenges in their own industry or domain.

We present a few ways in which you can be involved with Digital Catapult in this endeavour.

- Arrange to observe a walk-through of the system on a one-on-one basis, or download and use the demonstrator yourself
- Learn more about the inner workings of the demonstrator in both its functional and technical aspects
- Collaborate with Digital Catapult to develop a sandboxed implementation of the demonstrator in your own environment for learning and assessment around the workflow
- Consider how this demonstrator may provide clues to other forms of Distributed Systems that could solve similar problems in other domains and industries

- Refine the features of the demonstrator with more detail and accuracy to make the demonstrator ready for production at scale
- Offer advice to improve and grow the demonstrator into a real-world utility in the UK (or in other regions around the world)
- Help to develop principles that would establish an effective governance framework for deployment across the wider ecosystem and target higher operational efficiency in a real-world implementation

Please contact energy@digicatapult.org.uk to express your interest and we will respond to your enquiry as soon as possible.

We look forward to hearing from interested parties to engage in a productive collaboration to take this initiative further.

About Digital Catapult

Digital Catapult is a UK government-backed organisation with over a decade of experience in accelerating the adoption of advanced digital technologies within various industries.

Our mission is to accelerate industry adoption of advanced digital technologies, driving growth in the UK economy. We operate with a vendor-neutral and not-for-profit status.

Digital Catapult is one of the partner organisations in the Hydrogen Innovation Initiative (HII), supported by Innovate UK. By working with industry, government, and academia, HII aims to create an investible, globally competitive hydrogen technology and services sector here in the UK.

Inspiration

Beginning in late 2022 into early 2023, Digital Catapult undertook a series of structured industry engagements to define the leading challenges facing the nascent Hydrogen sector in the UK and determine which of these were most amenable to digital solutions.

Twenty-eight companies attended the in-person workshops at our offices, and eleven were followed up with structured interviews, identifying hydrogen certification as a leading opportunity for digitisation to accelerate the sector. We also discussed particular system features that may be useful in a hydrogen certification system in subsequent meetings with smaller groups chosen from the main workshops.

Subsequent to these engagements, and having narrowed down to the specific problem of low carbon certification to be solved first, Digital Catapult commenced the development of a functional demonstrator to showcase the opportunity for deploying advanced digital technologies to deliver a highly efficient and low-cost zero-trust UK-wide green hydrogen certification infrastructure.

Beginning in February 2023, the UK government launched a consultation into proposals for a Low Carbon Hydrogen Certification Scheme. HII responded to the consultation alongside 71 other stakeholders across the UK.

The government summarised and delivered their final report in October 2023.

Team

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